## REMARKS

Applicants respectfully submit that the claims are in condition for allowance. The Examiner is invited to contact the below-listed attorney if the Examiner believes that a telephone conference will advance the prosecution of this application.

March 8, 2002

Respectfully submitted,

Christopher J. Reckamp
Reg. No. 34,414

Vedder, Price, Kaufman & Kammholz
222 N. LaSalle Street, Suite 2600
Chicago, IL 60601-1104
(312) 609-7500
(312) 609-5005

## VERSION WITH MARKINGS TO SHOW CHANGES MADE

**In the Specification:**

On page 1, after the title, please replace the heading "Description" and substitute therefor the heading --Background of the Invention--.

On page 1, after the heading "Background of the Invention," please add the heading – Field of the Invention—so that the paragraph reads as follows:

Field of the Invention.

The present invention relates generally to Hall sensors and in particular to the arrangement and control of several Hall sensor elements in a Hall sensor array for magnetic field measurement with offset compensation.

On page 1, after the first paragraph under the "Field of the Invention" section, please insert the following heading: --Description of Related Art--.

On page 1, at the second paragraph of the "Description of Related Art" section, please replace the current paragraph and substitute the following paragraph therefor, so that the paragraph reads as follows:

A Hall sensor array in which two or four Hall sensor elements are used to compensate the disturbing effect of a particular crystal direction is known from the European patent specification EP-0548391 B1. The angular separation of the individual Hall sensor elements is fixed, lying between 0° and 180°. The angle is chosen according to the crystal direction of the semiconductor material which is used. According to EP-0548391 each Hall element is fed from a separate current source, so that a constant current is impressed on each element. The Hall voltages tapped off at the individual Hall elements in the Hall detector are connected in parallel in a switching stage. A common value is thus imposed on the Hall voltages of the individual elements, so that compensating currents may result.

On page 3, in the Summary of the Invention section, replace the first two paragraphs beginning at line 22 and substitute therefor the following paragraphs, so that the first two paragraphs read as follows:

[Starting from this prior art it]It is the object of the present invention to provide an improved Hall sensor array which is also less complicated to manufacture.

This object is achieved by a Hall sensor array comprising:

a first and at least one additional pair of Hall sensor elements,

wherein each Hall sensor element has four terminals, of which two terminals act as power supply terminals for supplying an operating current and two terminals act as measurement terminals for measuring a Hall voltage,

wherein the Hall sensor elements are so arranged that the current directions of the operating current in the two Hall sensor elements of each pair are offset at an angle of approximately 90° to one another,

wherein the Hall sensor elements of the additional pair(s) are so arranged that their current directions of the operating current are offset at an angle of approximately 90°/n to the current directions of the operating current of the first pair of Hall sensor elements, n being the total number of Hal sensor element pairs, and

wherein respective first terminals of the measurement terminals of the Hall sensor elements and respective second terminals of the measurement terminals of the Hall sensor elements are connected together for measurement of the Hall voltage,

wherein the Hall sensor array also has switches and wherein the respective terminals of the Hall sensor elements are connected to the switches, so that the respective first and second supply terminals for supplying an operating current and the respective first and second measurement terminals for measuring a Hall voltage can be switched over from one measurement to a subsequent measurement in such a way that the current directions of the operating current in the Hall sensor elements and the Hall voltage tapping directions can be rotated through approximately 90° from one measurement to a subsequent measurement,

wherein the Hall sensor array also has a controller by means of which the switches are controllable in such a way that the Hall sensor array is operable in spinning current operation for generating a Hall signal and wherein the offset voltages of the Hall sensor elements approximately cancel one another out in a revolution so that the Hall signal contributions which actually depend on the magnetic field remain, and

wherein respective first supply terminals of each Hall sensor element are connected together and to a first terminal of a common voltage source and respective second supply terminals of each Hall sensor element are connected together and to the second terminal of the common voltage source so that the common voltage source supplies an operating current for the Hall sensor elements[according to claim 1].

On page 5, please delete the paragraph beginning at line 17.

[The present invention provides a Hall sensor array for offset compensated magnetic field measurement which comprises a first and at least one additional pair of Hall sensor elements. Each Hall sensor element has four terminals, of which a first and a third terminal act as power supply terminals for supplying an operating current and a second and a fourth terminal set as measurement terminals for measuring a hall voltage. The Hall sensor elements are so arranged that the current directions of the operating current in the two Hall sensor elements of each pair are offset at an angle of approximately 90° to one another. The Hall sensor elements of the additional pair(s) are so arranged that their operating current directions are offset at an angle of approximately 90°/n to the operating current directions of the first pair of Hall sensor elements, n being the total number of Hall sensor element pairs and $n \geq 2$. The first terminals, the third terminals, the second terminals and the fourth terminals of the Hall sensor elements are respectively connected to each other electrically. The operating current can thus be supplied over the first and third terminals of all the Hall sensor elements and the Hall voltage can be measured over the second and fourth terminals of all the Hall sensor elements.]

On page 6, at line 18, please substitute the below paragraph for the indicating pending paragraph, so that the paragraph reads as follows:

According to the present invention, [The geometric arrangement and interwiring of] the Hall sensor elements are operated in [according to the present invention is particularly important for] the so-called "spinning current" mode[operation]. In spinning current operation the measurement direction is rotated continuously in a cycle by e.g. 90° at a particular clock frequency, i.e. the operating current flows from one electrode to the facing contact electrode, the Hall voltage being tapped off at the transverse contact electrodes, whereupon the measurement direction is rotated through 90° at the next cycle, i.e. the next measurement phase. The Hall voltages measured in the individual measurement phases are

evaluated by a suitable correctly signed and weighted summation or subtraction. The offset still contained in the individual measurement phases can be reduced still further or the offset voltages during a revolution should roughly cancel one another out, so that the parts of the Hall signal which really depend on the magnetic field are retained.

**In the Claims**

Please amend Claims 1-2 and 8-9 as follows. In particular, please substitute the below claims for the indicated pending claims with the same number.

1. (Once Amended) A Hall sensor array comprising:

a first [(1A, 1B) ]and at least one additional pair[ 2A, 2B,; 2A, 2B, 3A, 3B)] of Hall sensor elements,

wherein each hall sensor element[ (1A, 1B, 2A, 2B; 1A, 1B, 2A, 2B, 3A, 3B)] has four terminals[ (K1, K2, K3, K4)], of which two [a first and a third] [terminal]terminals [(K1, K2)] act as power supply terminals for supplying an operating current[ ($I_{operation}$)] and two [a second and a fourth terminal]terminals act as measurement terminals for measuring a Hall voltage[($U_{Hall}$)],

wherein the Hall sensor elements [(1A, 1B, 2A, 2B; 1A, 1B, 2A, 2B, 3A, 3B)]are so arranged that the current directions of the operating current [($I_{operation}$) ]in the two Hall sensor elements of each pair are offset at an angle of approximately 90° to one another,

wherein the Hall sensor elements[(2A, 2B; 2A, 2B, 3A, 3B;)] of the additional pair(s) are so arranged that their [operating]current directions of the operating current are offset at an angle of approximately 90°/n to the current directions of the operating current [directions]of the first pair [(1A, 1B)]of Hall sensor elements, n being the total number of Hall sensor element pairs[and $n \geq 2$], and

wherein respective[the] first terminals of the measurement terminals[terminal (K1), the third terminals (K3), the second terminals (K2) and the fourth terminals (K4)] of the Hall sensor elements [(1A, 1B, 2A, 2B; 1A, 1B, 2A, 2B, 3A, 3B) are respectively]and respective second terminals of the measurement terminals of the Hall sensor elements are connected together for measurement of the Hall voltage,

wherein the Hall sensor array also has switches and wherein the respective terminals of the Hall sensor elements are connected to the switches, so that the respective first and second supply terminals for supplying an operating current and the respective first and second measurement terminals for measuring a Hall voltage can be switched over from one measurement to a subsequent measurement in such a way that the current directions of the operating current in the Hall sensor elements and the Hall voltage tapping directions can be rotated through approximately 90° from one measurement to a subsequent measurement, [each other electrically, thus permitting the operating element ($I_{operation}$) to be supplied over the electrically interlinked first and third terminals (K1, K3) of all the Hall sensor elements and the Hall voltage ($U_{Hall}$) to be measured over the electrically interlinked second and fourth terminals (K2, K4) of all the Hall sensor elements (1A, 2A, 2B; 1A, 1B, 2A, 2B, 3A, 3B)]

wherein the Hall sensor array also has a controller by means of which the switches are controllable in such a way that the Hall sensor array is operable in spinning current operation for generating a Hall signal and wherein the offset voltages of the Hall sensor elements approximately cancel one another out in a revolution so that the Hall signal contributions which actually depend on the magnetic field remain, and

wherein first supply terminals of each Hall sensor element are connected together and to a first terminal of a common voltage source and respective second supply terminals of each Hall sensor element are connected together and to the second terminal of the common voltage source so that the common voltage source supplies an operating current for the Hall sensor elements.

2. (Once Amended) Hall sensor array according to claim 1, wherein the first supply terminals [(K1] are connected together electrically by being interwired, [the third terminals (K3),]the second supply terminals[ (K2]are connected together electrically by being interwired, [and the fourth ]the first measurement terminals [(K4) of the Hall sensor elements (1A, 1B, 2A, 2B; 1A, 1B, 2A, 2B, 3A, 3B)] are [respectively] connected together electrically by being interwired and the second measurement terminals are connected together electrically by being interwired.

[3. Hall sensor array according to claim 1 or 2, wherein the Hall sensor elements of the first and the second pair respectively are arranged next to each other.]

[4. Hall sensor array according to claim 1 or 2, wherein the Hall sensor elements of the first and the second pair are arranged along a diagonal.]

[5. Hall sensor array according to one of the claims 1 to 4, wherein the Hall sensor elements of the first and the second pair are arranged close to one another relative to the dimensions of the Hall sensor elements.]

[6. Hall sensor array according to one of the claims 1 to 5, which also includes switches (S1, S2, S3, S4) and where the terminals (K1, K2, K3, K4) of the Hall sensor elements (1A, 1B, 2A, 2B) are connected to the switches (S1, S2, S3, S4), so that the power supply terminals for supplying an operating current ($I_{operation}$) and the measurement terminals for measuring a Hall voltage ($U_{Hall}$) can be switched through 90° from one measurement to the next.

[7. Hall sensor array according to one of the claims 1 to 6, which also includes a control unit by means of which the switches (S1, S2, S3, S4) are controllable in such a way that the Hall sensor array is operable in spinning current operation.]

8. Hall sensor array according to [one of the]claim[s] 1 [to 7], wherein the Hall sensor elements of a pair are geometrically identical.

9. Hall sensor array according to [one of the] claim[s] 1 [to 8], wherein the Hall sensor elements of different pairs are geometrically different.

**In the Abstract:**

Please delete the current paragraph in the Abstract section, and substitute therefor the below paragraph so that the Abstract to reads as follows:

[Hall Sensor Array for Measuring a Magnetic Field with Offset Compensation]

ABSTRACT

A Hall sensor array for offset-compensated magnetic field measurement comprises a first [(1A, 1B)] and at least one additional pair[(2A, 2B, 2A, 2B, 3A, 3B)] of Hall sensor elements. Each Hall sensor element [(1A, 1B, 2A, 2B; 1A, 1B, 2A, 2B, 3A, 3B)] has four terminals [(K1, K2, K3, K4)], of which two [a first and a third terminal (K1, K3)] act as power supply terminals for supplying an operating current [($I_{operation}$) ]and two [a second and

a fourth terminal (K2, K4) ]act as measurement terminals for measuring a Hall voltage[ ($U_{Hall}$)]. Respective first supply terminals of each Hall sensor element are connected together and to a first terminal of a common voltage source and respective second supply terminals of each Hall sensor element are connected together and to a second terminal of the common voltage source so that the common voltage source supplies an operating current for the Hall sensor elements. The Hall sensor elements [(1A, 1B, 2A, 2B; 1A, 1B, 2A, 2B, 3A, 3B)] are operated in the spinning current mode so that the offset voltages of the Hall sensor elements approximately cancel one another out in a revolution so that the Hall signal contributions which actually depend on the magnetic field remain[so arranged that the current directions of the operating current ($I_{operation}$) in the two Hall sensor elements of each pair are offset at an angle of approximately 90° to one another. The Hall sensor elements (2A, 2B; 2A, 2B, 3A, 3B) of the additional pair(s) are so arranged that their operating current directions are offset at an angle of approximately 90°/n to the operating current directions of the first pair (1A, 1B) of Hall sensor elements, n being the total number of Hall sensor element pairs and $n \geq 2$. The first terminals (K1), the third terminals (K3), the second terminals (K2) and the fourth terminals (K4) of the Hall sensor elements (1A, 1B, 2A, 2B; 1A, 1B, 2A, 2B, 3A, 3B) are respectively connected to each other electrically. The operating current ($I_{operation}$) can thus be supplied over the first and third terminals (K1, K3) of all the Hall sensor elements and the Hall voltage ($U_{Hall}$) can be measured over the second and fourth terminals (K2, K4) of all the Hall sensor elements (1A, 1B, 2A, 2B; 1A, 1B, 2A, 2B, 3A, 3B)].